llττ final states

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Outline

Motivation

- Triple Gauge Couplings and Anomalous ZZ couplings
- Higgs searches

Analysis

- Z reconstruction
- Higgs reconstruction
- Collinear approximation
- Backgrounds

Summary and Outlook

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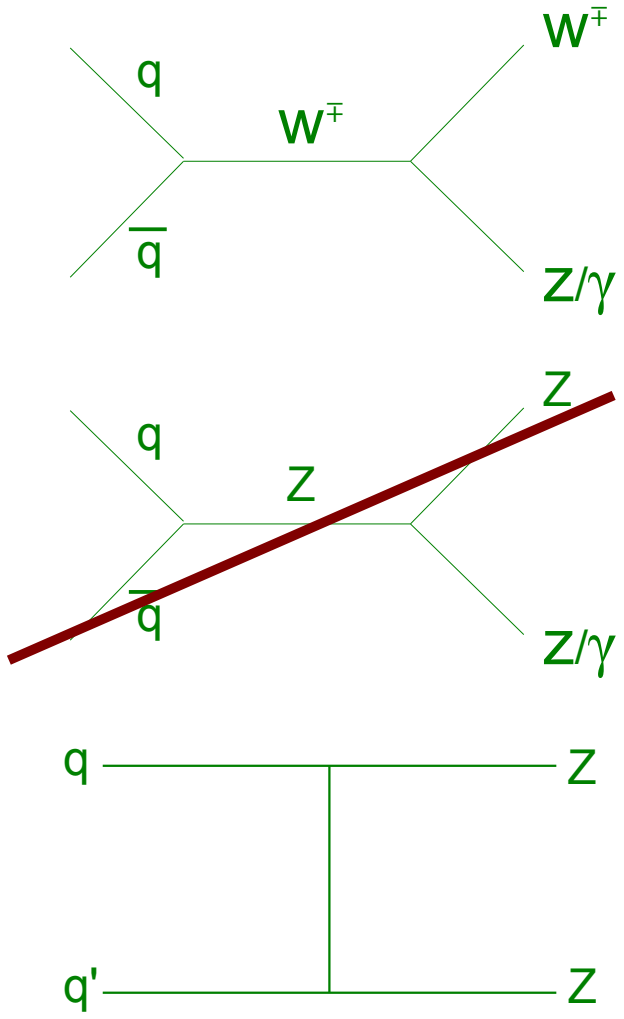
Triple Gauge Couplings

3-Vector-Boson vertizes:

- $qq \rightarrow W \rightarrow WZ$, $qq \rightarrow W \rightarrow W\gamma$

  σ = 57.7 pb

- $qq \rightarrow Z \rightarrow ZZ$, $qq \rightarrow Z \rightarrow Z\gamma$
  - tree level: $\sigma = 0$
    (no charge or weak isospin)
  - Higher order contributions
    $\sigma = 10^{-4}\,\sigma(t\text{-channel})$



Di-Boson production:

- t-channel

  σ = 16.8 pb

Talk by Z. Zhao, ICHEP'06

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Anomalous ZZ couplings

Beyond standard model:

- form factors
  - ➔ effective Lagrangian
- coupling split in
  - f_4: CP violating
  - f_5: CP conserving

➔ **probe mass scale beyond center-of-mass energy**

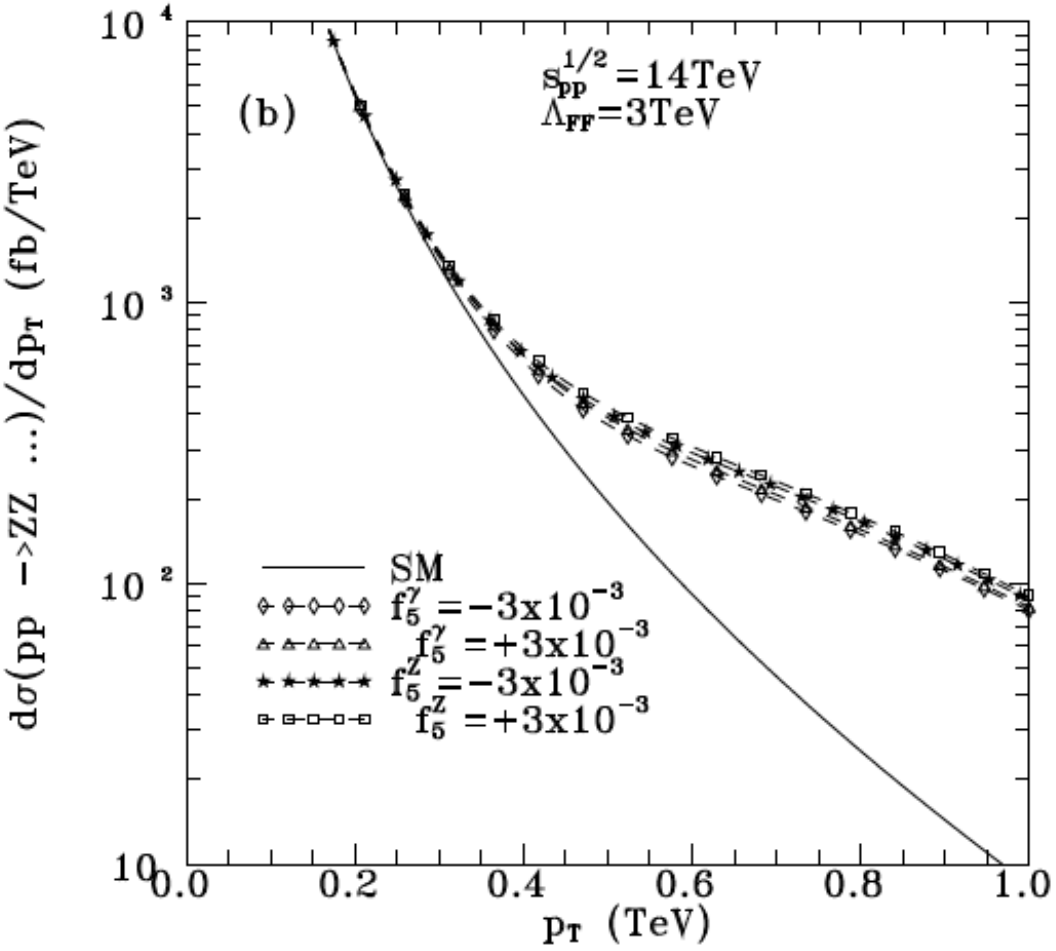
Measurement:

- ZZ cross section

Events per 1 fb^{-1}

- CMS: 7.1 Sig / 0.4 Bgd
- ATLAS: 13 Sig / (0/?) Bgd

Only e, μ considered so far!



G. Gournais et al., hep-ph/9910395

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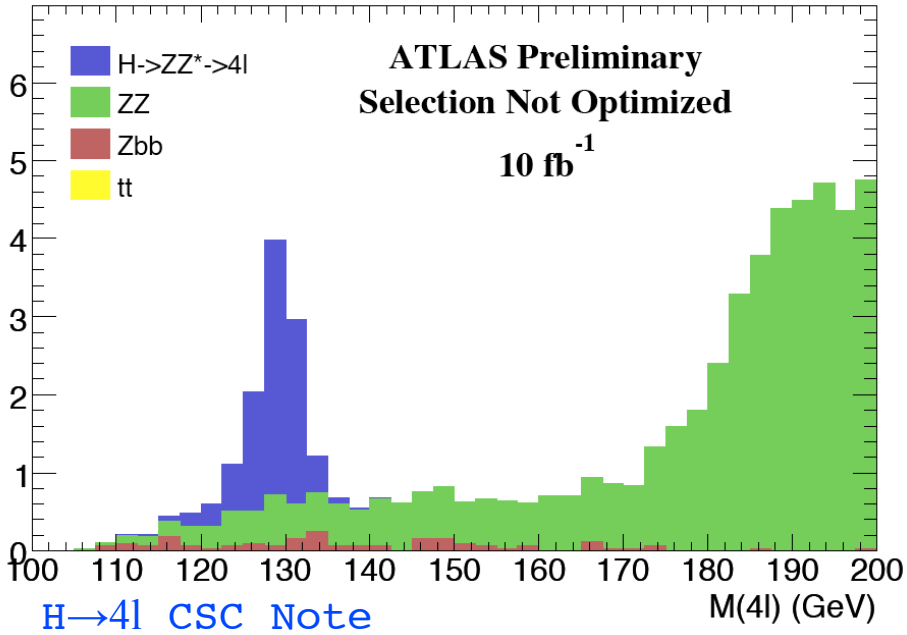
Higgs searches

4-lepton searches:

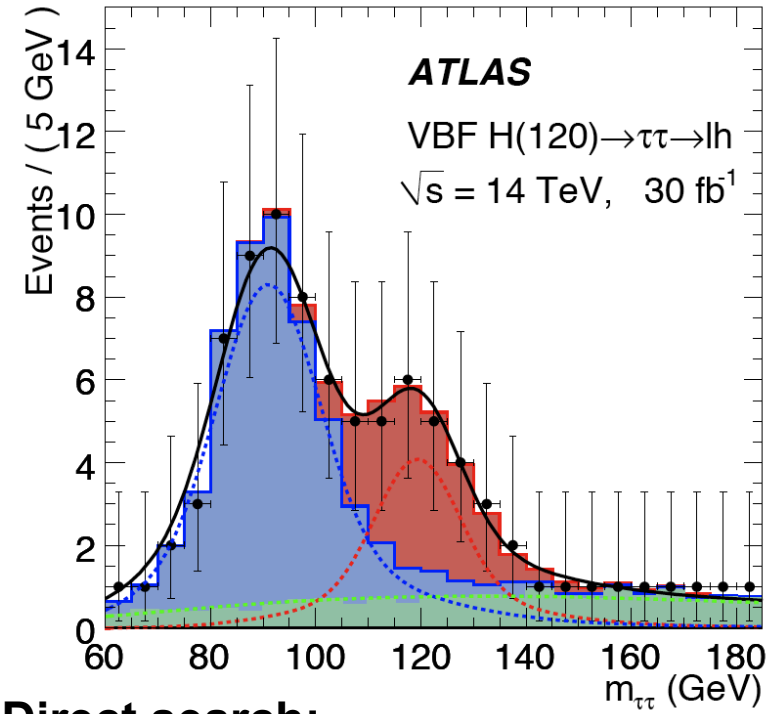
- important background: ZZ → 4l
  - ➔ measure ZZ cross section
- in signal currently lepton = e or μ
  - ➔ missing 5 out of 9 cases

Is it possible to increase the significance / systematics with taus?



H→4l CSC Note

VBF H→ττ CSC Note



Direct search:

- Higgs-Strahlung
  ZH → llττ
- from VBF: very little background

Can this channel add to Higgs searches at low Higgs mass ?

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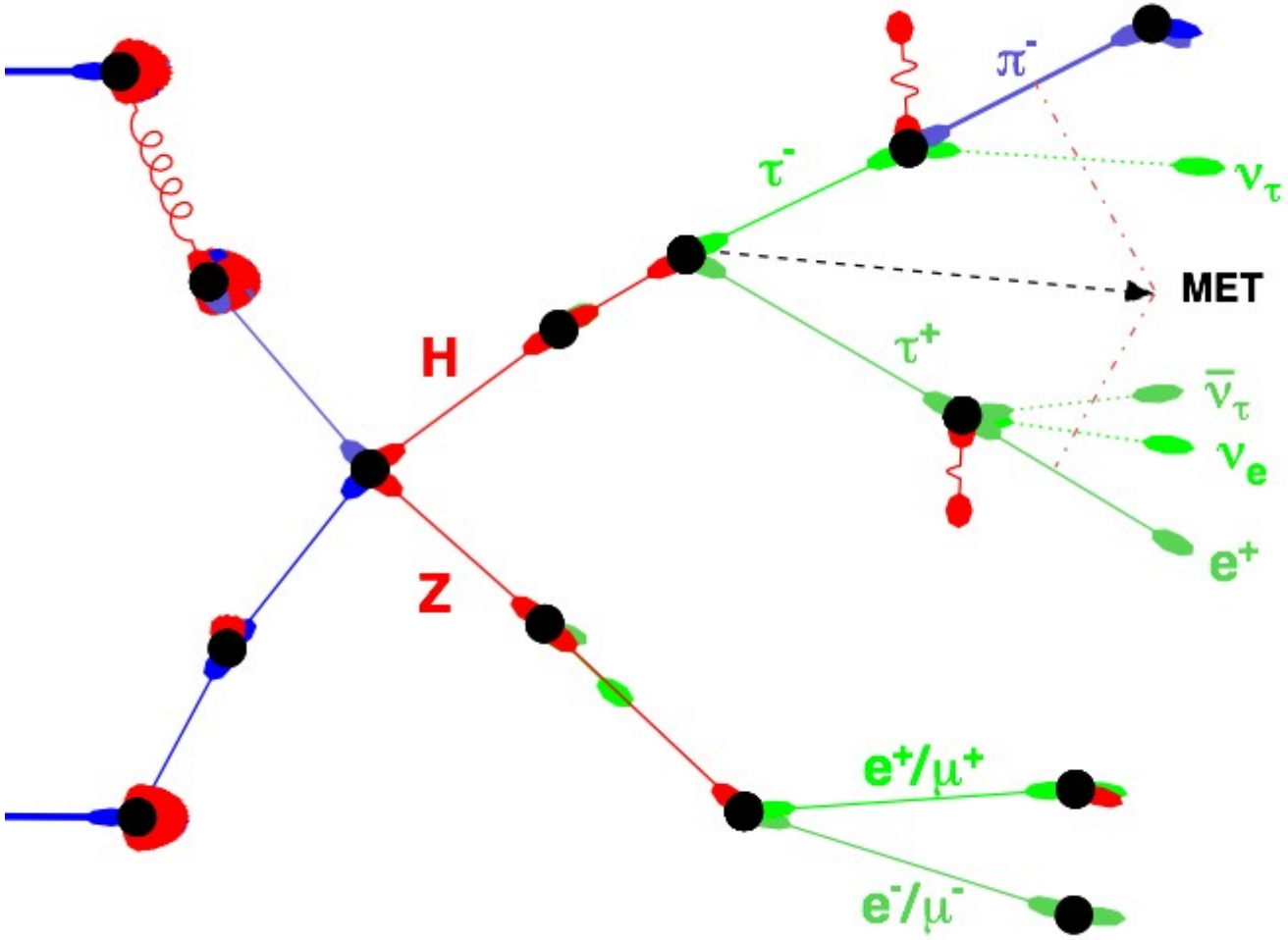
Reconstruction strategy



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Z reconstruction

Electrons:

- $p_T > 5$ GeV , $|\eta| < 2.5$
- PID = *ElectronLoose*

Muons:

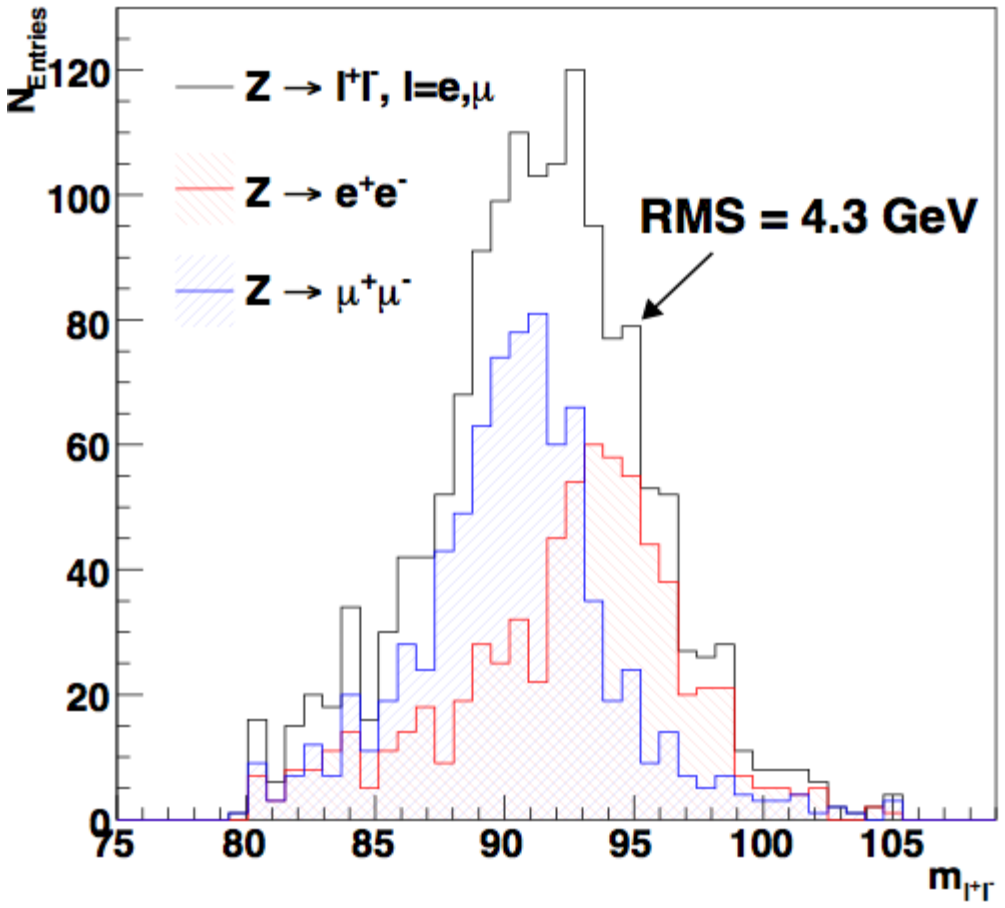
- $p_T > 6$ GeV , $|\eta| < 2.5$

Z reconstruction:

- opposite charged pair
- l^+l^- inv. mass closest to m_Z
- 80 GeV < $m_{l^+l^-}$ < 105 GeV

Efficiency:

- ZZ: 61.0% ± 3.3%
- ZH: 68.3% ± 1.8%
- Zbb:85.3% ± 0.6%



Why is there a shift in the electron peak ?
Why are the reconstruction efficiencies so different?

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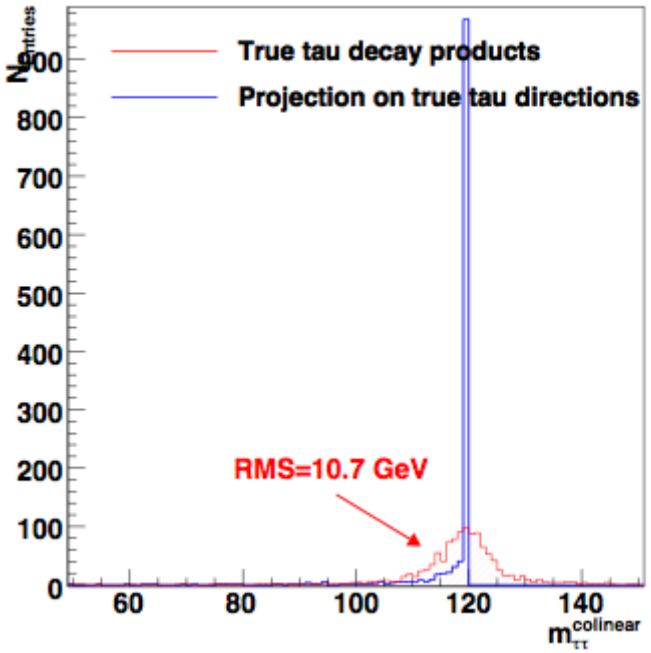
Collinear approximation

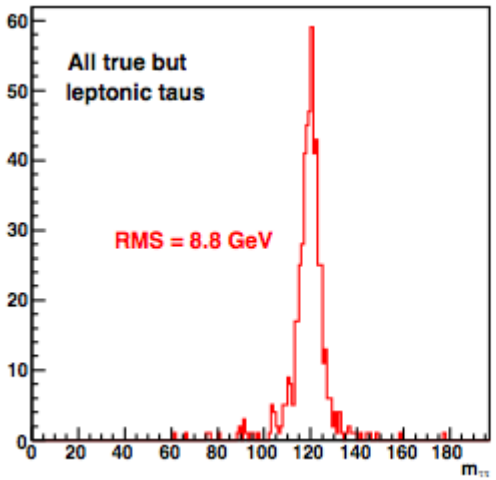


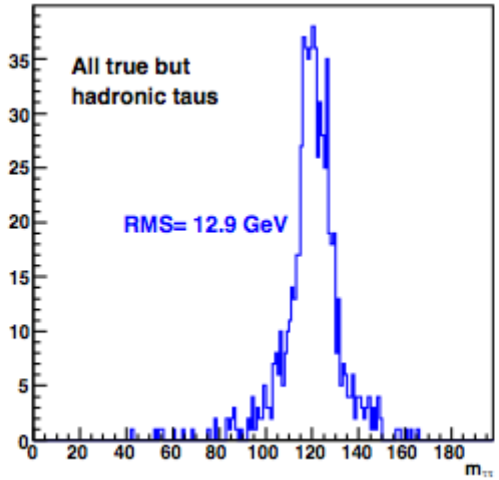
Width of Higgs mass peak

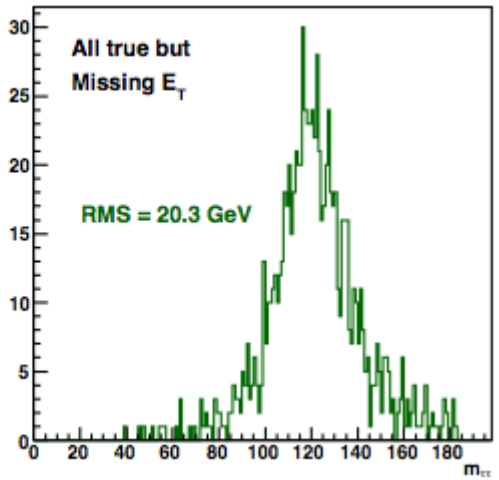
- collinear approximation: 10.7 GeV
- missing E_T reconstruction: 17.3 GeV
- total: **24.7 GeV**

➔ limits resolution

Can we improve Missing ET resolution?







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Higgs reconstruction

Tau decay products

- opposite charge pairs
- remove overlap within $\Delta R < 0.2$
  ➔ precedence: τ, μ, e

Electrons:

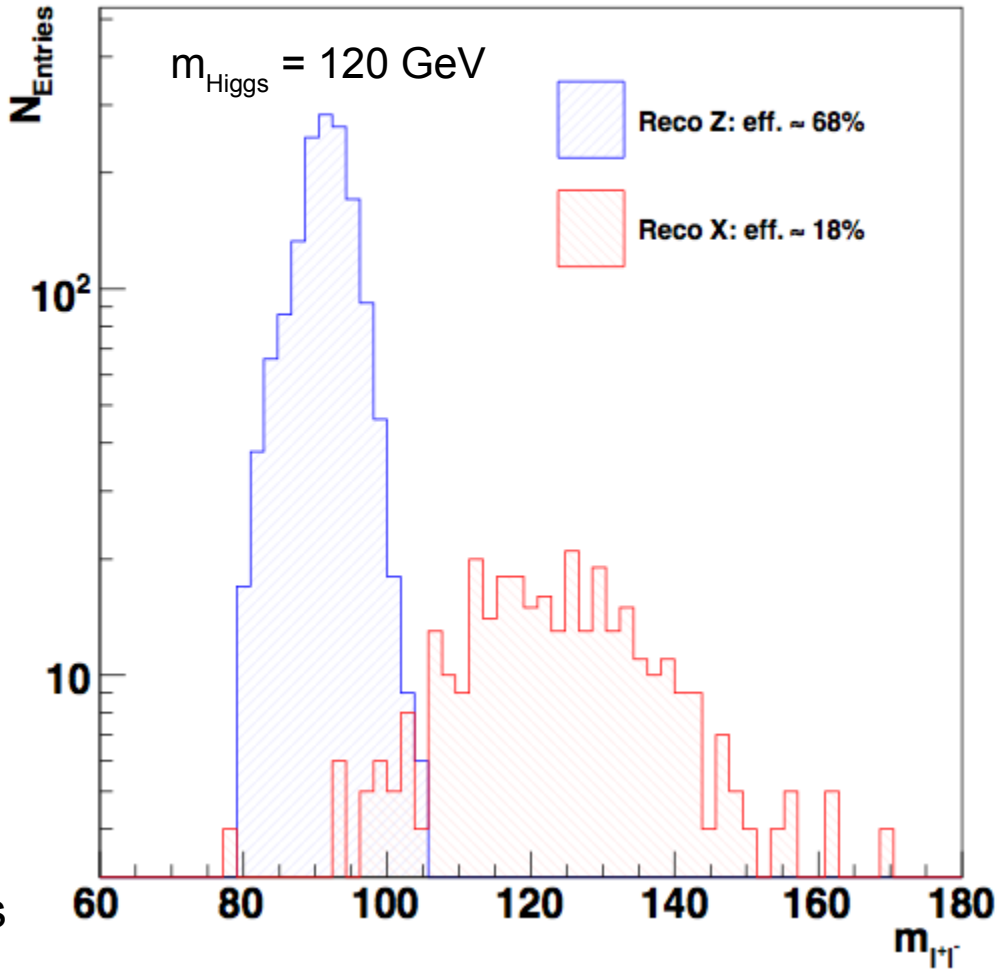
- $p_T > 20$ GeV, no isolation

Muons:

- $\chi^2 < 5$, $E_T^{(\Delta R < 0.20)}/p_T < 0.15$

Tau jets:

- *Tau1p3pContainer*
- $p_T > 20$ GeV , $|\eta| < 2.5$
- $\varepsilon_{NN} > 0.1$
  ➔ 90% efficiency on true taus



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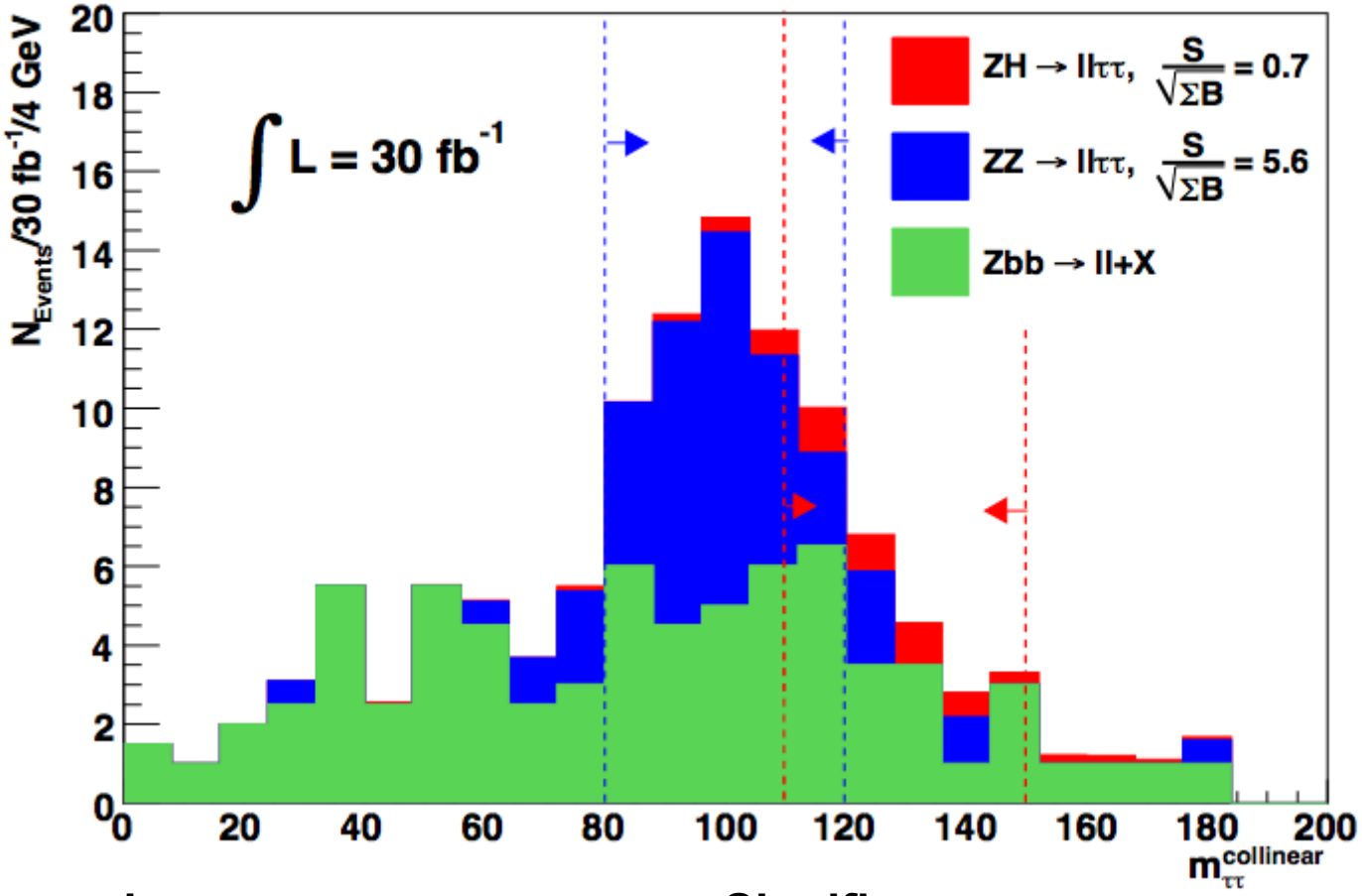
Background(s)



Backgrounds

- from VBF H→ττ: Zbb dominant
- possibly also Z+jets

Significance:

- ZZ: good significance
- ZH: needs better background rejection

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Summary and Outlook

Di-Boson searches are interesting as

- indirect new physics searches
- background for 4-Lepton Higgs searches

llττ final states can possibly

- improve ZZ cross-section measurement
- contribute to direct Higgs searches

This analysis mainly lacks

- larger (background) MonteCarlo samples
- more thorough lepton preselection
- cut optimization
- investigation of systematics

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